INTERNATIONAL STANDARD

ISO 11898-2

Second edition
2016-12-15

Road vehicles — Controller area network (CAN) —

Part 2: High-speed medium access unit

Véhicules routiers — Gestionnaire de réseau de communication (CAN) —

Partie 2: Unité d'accès au support à haute vitesse

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 31, *Data communication*.

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This second edition cancels and replaces the first edition (ISO 11898-2:2003), which has been technically revised, with the following changes:

— max output current on CANH/CANL has been defined (Table 4);

— optional TXD timeout has been defined (Table 7);

— receiver input resistance range has been changed (Table 10);

— Bit timing parameters for CAN FD for up to 2 Mbps have been defined (Table 13);

— Bit timing parameters for CAN FD for up to 5 Mbps have been defined (Table 14);

— content of ISO 11898-5 and ISO 11898-6 has been integrated to ensure there is one single ISO Standard for all HS-PMA implementations;

— selective wake-up (formerly ISO 11898-6) CAN FD tolerance has been defined;

— wake-filter timings (formerly in ISO 11898-5) have been changed (Table 20)

— requirements and assumptions about the PMD sublayer have been shifted to Annex A, to clearly focus on the HS-PMA implementation.

A list of all parts in the ISO 11898 series can be found on the ISO website.

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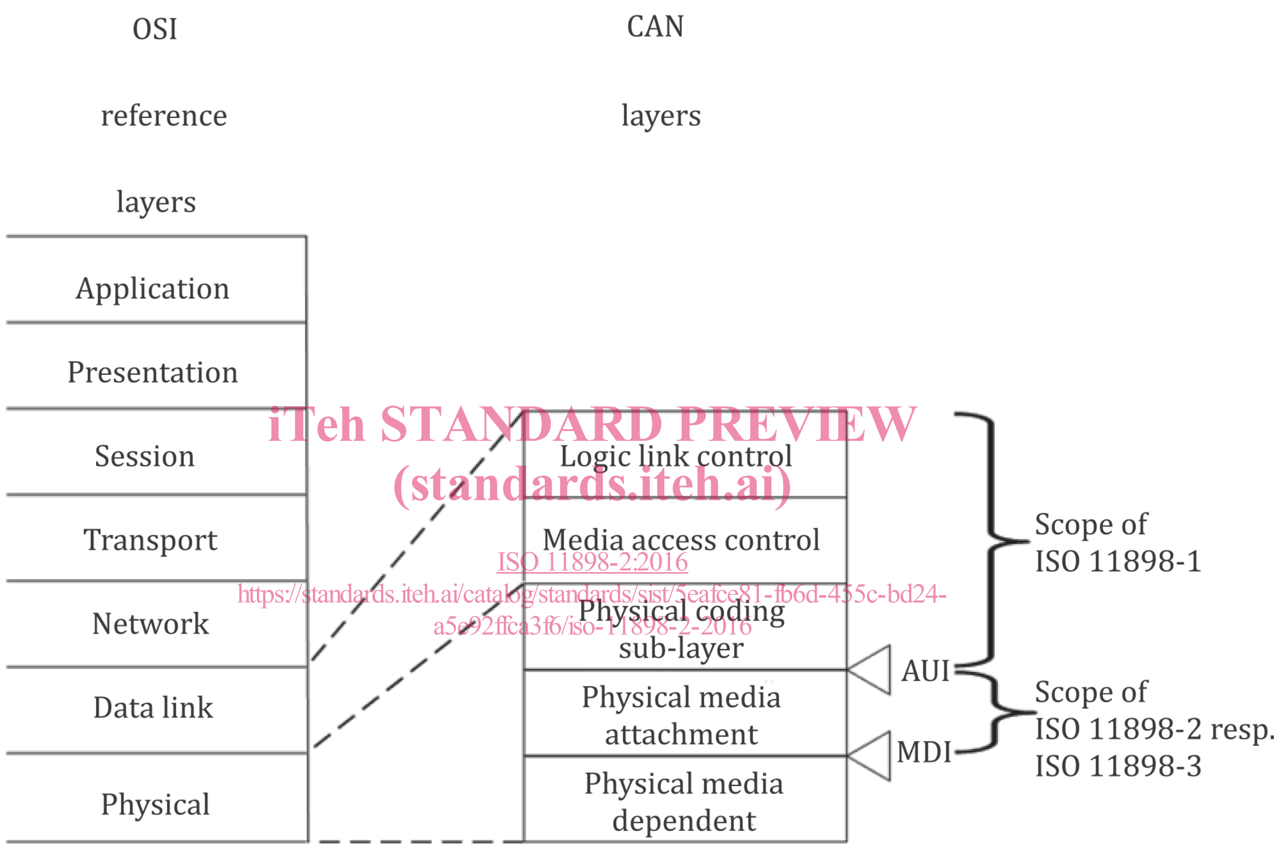
Introduction

ISO 11898 was first published as one document in 1993. It covered the CAN data link layer as well as the high-speed physical layer. In the reviewed and restructured ISO 11898 series, ISO 11898-1 and ISO 11898-4 defined the CAN protocol and time-triggered CAN (TTCAN) while ISO 11898-2 defines the high-speed physical layer, and ISO 11898-3 defined the low-speed fault tolerant physical layer.

Figure 1 shows the relation of the Open System Interconnection (OSI) layers and its sublayers to ISO 11898-1, this document as well as ISO 11898-3.



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Key

AUI attachment unit interface

MDI media dependant interface

OSI open system interconnection

Figure 1 — Overview of ISO 11898 specification series

The International Organization for Standardization (ISO) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning the selective wake-up function given in 5.9.4.

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Road vehicles — Controller area network (CAN) —

Part 2: High-speed medium access unit

1 Scope

This document specifies the high-speed physical media attachment (HS-PMA) of the controller area network (CAN), a serial communication protocol that supports distributed real-time control and multiplexing for use within road vehicles. This includes HS-PMAs without and with low-power mode capability as well as with selective wake-up functionality. The physical media dependant sublayer is not in the scope of this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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ISO 11898-1:2015, *Road vehicles — Controller area network (CAN) — Part 1: Data link layer and physical signalling*

ISO 16845-2, *Road vehicles — Controller area network (CAN) conformance test plan — Part 2: High-speed medium access unit with selective wake-up functionality*

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3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11898-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

NOTE See Figure A.1 for a visualization of the definitions.

3.1
attachment unit interface
AUI
interface between the PCS that is specified in ISO 11898-1 and the PMA that is specified in this document

3.2
ground
GND
electrical signal ground

3.3
legacy implementation
HS-PMA implementation that has been released prior to the publication of this document

3.4
low-power mode
mode in which the transceiver is not capable of transmitting or receiving messages, except for the purposes of determining if a WUP or WUF is being received

3.5
medium attachment unit
MAU
unit that comprises the physical media attachment and the media dependent interface

3.6
media dependent interface
MDI
interface that ensures proper signal transfer between the media and the physical media attachment

3.7
normal-power mode
mode in which the transceiver is fully capable of transmitting and receiving messages

3.8
physical coding sublayer
PCS
sublayer that performs bit encoding/decoding and synchronization

3.9
physical media attachment
PMA
sublayer that converts physical signals into logical signals and vice versa

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3.10
transceiver
implementation that comprises one or more physical media attachments

4 Symbols and abbreviated terms

For the purposes of this document, the symbols and abbreviated terms given in ISO 11898-1 and the following apply. Some of these abbreviations are also defined in ISO 11898-1. If the definition of the term in this document is different from the definition in ISO 11898-1, this definition applies.

AUI attachment unit interface

DLC data length code

EMC electromagnetic compatibility

ESD electro static discharge

GND ground

HS-PMA high-speed PMA

MAU medium attachment unit

MDI media dependent interface

PCS physical coding sublayer

PMA physical media attachment

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PMD physical media dependent

WUF wake-up frame

WUP wake-up pattern

5 Functional description of the HS-PMA

5.1 General

The HS-PMA comprises one transmitter and one receiving entity. It shall be able to bias the connected physical media, an electric two-wire cable, relative to a common ground. The transmitter entity shall drive a differential voltage between the CAN_H and CAN_L signals to signal a logical 0 (dominant) or shall not drive a differential voltage to signal a logical 1 (recessive) to be received by other nodes connected to the very same media. These two signals are the interface to the physical media dependent sublayer.

The HS-PMA shall provide an AUI to the physical coding sublayer as specified in ISO 11898-1. It comprises the TXD and RXD signals as well as the GND signal. The TXD signal receives from the physical coding sublayer the bit-stream to be transmitted on the MDI. The RXD signal transmits to the physical coding sublayer the bit-stream received from the MDI.

Implementations that comprise one or more HS-PMAs shall at least support the normal-power mode of operation. Optionally, a low-power mode may be implemented.

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Some of the items specified in the following depend on the operation mode of the (part of the) implementation, in which the HS-PMA is included.

Table 1 shows the possible combinations of HS-PMA operating modes and expected behaviour.

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Table 1 — HS-PMA operating modes and expected behaviour

Operating mode	Bus biasing behaviour	Transmitter behaviour
Normal	Bus biasing active	Dominant or recessive[a]
Low-power	Bus biasing active or inactive	Recessive

[a] Depends on input conditions as described in this document.

All parameters given in this subclause shall be fulfilled throughout the operating temperature range and supply voltage range (if not explicitly specified for unpowered) as specified individually for every HS-PMA implementation.

5.2 HS-PMA test circuit

The outputs of the HS-PMA implementation to the CAN signals are called CAN_H and CAN_L, TXD is the transmit data input and RXD is the receive data output. Figure 2 shows the external circuit that defines the measurement conditions for all required voltage and current parameters. R_L represents the effective resistive load (bus load) for an HS-PMA implementation, when used in a network, and C_1 represents an optional split-termination capacitor. The values of R_L and C_1 vary for different parameters that the HS-PMA implementation needs to meet and are given as condition in Tables 2 to 20.

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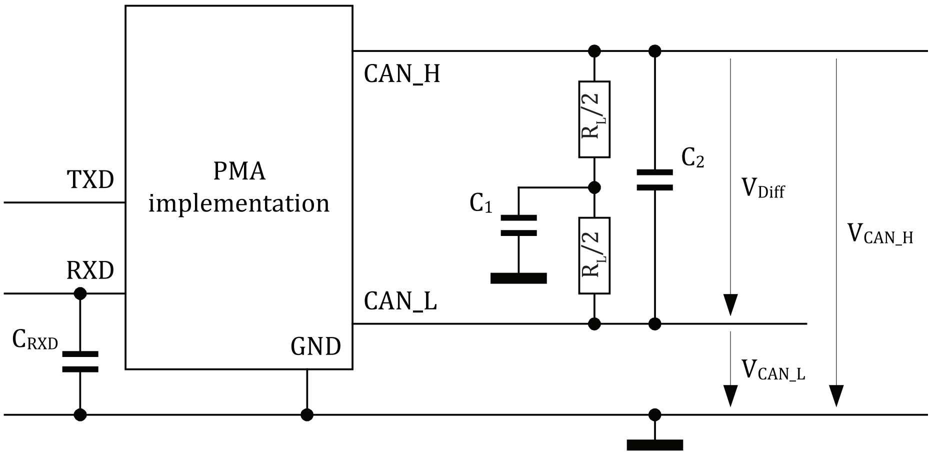

Key

V_{Diff} differential voltage between CAN_H and CAN_L wires

V_{CAN_H} single ended voltage on CAN_H wire

V_{CAN_L} single ended voltage on CAN_L wire

C_{RXD} capacitive load on RXD

Figure 2 — HS-PMA test circuit

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5.3 Transmitter characteristics

This subclause specifies the transmitter characteristics of a single HS-PMA implementation under the conditions as depicted in Figure 2; so no other HS-PMA implementations are connected to the media. The behaviour of an HS-PMA implementation connected to other HS-PMAs is outside the scope of this subclause. Refer to A.2 for consideration when multiple HS-PMAs are connected to the same media. The voltages and currents that are required on the CAN_L and CAN_H signals are specified in Tables 2 to 6. Table 2 specifies the output characteristics during dominant state.

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Figure 3 illustrates the voltage range for the dominant state.

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Table 2 — HS-PMA dominant output characteristics

Parameter	Notation	Value			Condition
		Min V	Nom V	Max V	
Single ended voltage on CAN_H	V_{CAN_H}	+2,75	+3,5	+4,5	R_L = 50 Ω ...65 Ω
Single ended voltage on CAN_L	V_{CAN_L}	+0,5	+1,5	+2,25	R_L = 50 Ω ...65 Ω
Differential voltage on normal bus load	V_{Diff}	+1,5	+2,0	+3,0	R_L = 50 Ω ...65 Ω
Differential voltage on effective resistance during arbitration	V_{Diff}	+1,5	Not defined	+5,0	R_L = 2 240 Ω[a]
Optional: Differential voltage on extended bus load range	V_{Diff}	+1,4	+2,0	+3,3	R_L = 45 Ω ...70 Ω

[a] 2 240 Ω is emulating a situation with up to 32 nodes sending dominant simultaneously. In such case, the effective load resistance for a single node decreases (a node does drive only a part of the nominal bus load). Assuming a MAX R_L of 70 Ω, this scenario covers a 32 nodes network. (2 240 Ω/70 Ω per node = 32 nodes.)

All requirements in this table apply concurrently. Therefore, not all combinations of V_{CAN_H} and V_{CAN_L} are compliant with the defined differential voltage (see Figure 3).

Measurement setup according to Figure 2 (only one HS-PMA present):

R_L, see "Condition" column above

C_1 = 0 pF (not present)

C_2 = 0 pF (not present)

C_{RXD} = 0 pF (not present)

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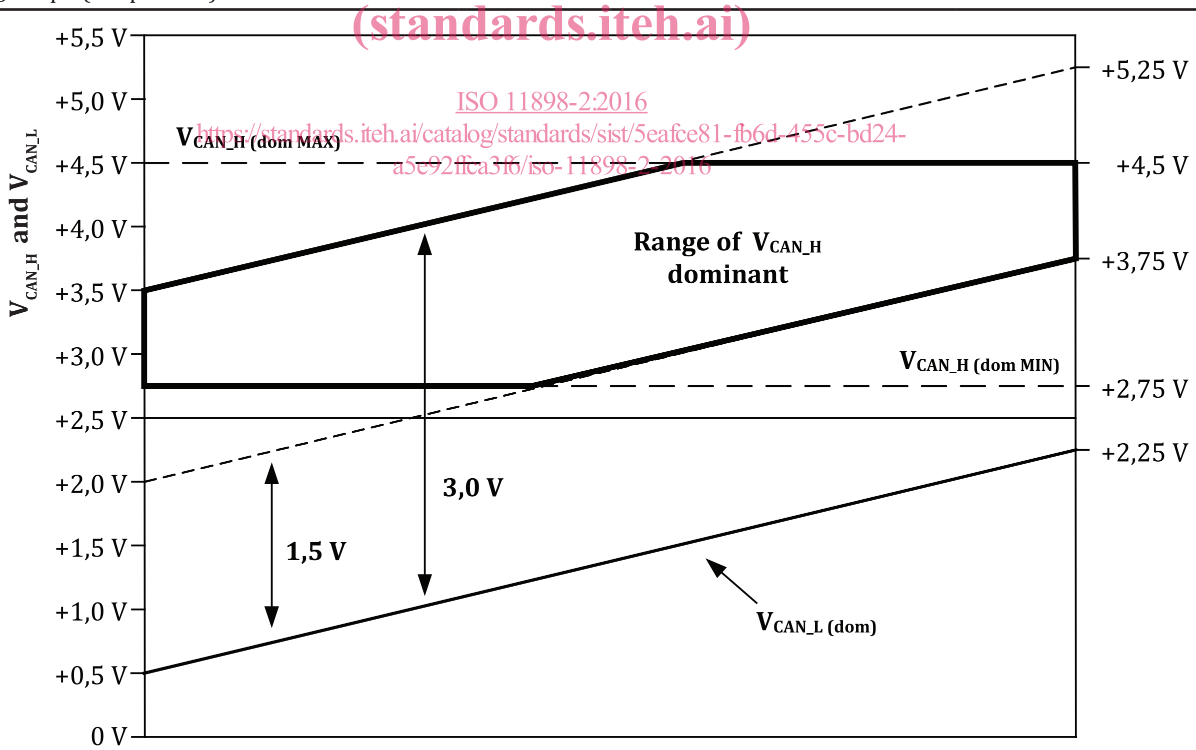

Key

V_{Diff} differential voltage between CAN_H and CAN_L wires

V_{CAN_H} single ended voltage on CAN_H wire

V_{CAN_L} single ended voltage on CAN_L wire

Figure 3 — Voltage range of V_{CAN_H} during dominant state of CAN node, when V_{CAN_L} varies from minimum to maximum voltage level (50 Ω ... 65 Ω bus load condition)

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In order to achieve a level of RF emission that is acceptably low, the transmitter shall meet the driver signal symmetry as required in Table 3.

Table 3 — HS-PMA driver symmetry

Parameter	Notation	Value		
		Min	Nom	Max
Driver symmetry[a]	v_{sym}	+0,9	+1,0	+1,1

[a] $v_{sym} = (V_{CAN\_H} + V_{CAN\_L})/V_{CC}$, with V_{CC} being the supply voltage of the transmitter.

v_{sym} shall be observed during dominant and recessive state and also during the transition from dominant to recessive and vice versa, while TXD is stimulated by a square wave signal with a frequency that corresponds to the highest bit rate for which the HS-PMA implementation is intended, however, at most 1 MHz (2 Mbit/s) (HS-PMA in normal mode).

Measurement setup according to Figure 2:

R_L = 60 Ω (tolerance ≤ ±1 %)

C_1 = 4,7 nF (tolerance ≤ ±5 %)

C_2 = 0 pF (not present)

C_{RXD} = 0 pF (not present)

The maximum output current of the transmitter shall be limited according to Table 4.

Table 4 — Maximum HS-PMA driver output current

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Parameter	Notation	Value		Condition
		Min mA	Max mA	
Absolute current on CAN_H	I_{CAN_H}	not defined	115	$-3\ V \leq V_{CAN\_H} \leq +18\ V$
Absolute current on CAN_L	I_{CAN_L}	not defined	115	$-3\ V \leq V_{CAN\_L} \leq +18\ V$

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Measurement setup according to Figure 2 with either V_{CAN_H} or V_{CAN_L} enforced to voltage levels as mentioned in the conditions by connection to an external voltage source, while the HS-PMA is driving the output dominant. The absolute maximum value does not care about the direction in which the current flows.

$R_L > 10^{10}$ Ω (not present)

C_1 = 0 pF (not present)

C_2 = 0 pF (not present)

C_{RXD} = 0 pF (not present)

NOTE It is expected that the implementation does not stop driving its output dominant when the differential voltage between CAN_H and CAN_L is outside the limits given in the Condition column. The minimum output current is implicitly defined in Table 2 and thus can be expected to be above 30 mA.

Table 5 specifies the recessive output characteristics when bus biasing is active.

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